International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 8 ǁ 2021 ǁ PP. 26-34

Analysis of Telecommunication Tower with K Bracing & X Bracing In Low Wind Intensity Zone

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Abstract
Buildings are constructed to provide shelter for people and for commercial uses. Due to rapid increment in population and higher rate of growth in industries there is a large demand for land. In design practices, randomly varying phenomenon is a wind which is having significant dynamic effect on structures especially on flexible high rise building. Over the past 30 years, the growing demand for wireless and broadcast communication has spurred a dramatic increase in communication tower construction and maintenance. Failure of structures is a major concern. In this paper a comparative analysis is being carried out for G+30 towers using different bracing patterns for low Wind intensity zone of India. Gust factor method is used for wind load analysis. The main objective of this paper is to compare Indian Standard code of practice for wind loads IS 875:2015 (part 3) loading on structure G+30 storey high rise building in low wind intensity zone with terrain category using *ETABS software. It is performed on building to identify the gust factor, lateral force, intensity, storey drift and displacement, comparison of results which is obtained from software after assigning the data along both "X" and "Y" direction are plotted in graph. Comparative analysis results comes with X & K Bracing in these criteria, gust factor, storey lateral load, overturning moment, storey drift, storey displacement.*
Keywords: *Wind Analysis, X Bracing, K Bracing, Gust Factor Method, Telecommunication Tower,Modal Analysis*

Date of Submission: 16-07-2021 Date of acceptance: 01-08-2021

I. INTRODUCTION

Telecommunication towers have become an indispensable thing particularly in wireless telecommunication sector with the expansion of wireless telecommunication technologies such as CDMA (Code Division Multiple Access), GSM (Global System for Mobile), and WAP (wireless Web Access). In the human civilization at the moment the telecommunication structures are elementary mechanism of communication. Telecommunication towers are characteristically tall structures whose purpose is to sustain elevated antennas for radio and television broadcasting, telecommunication and two-way radio systems. In addition, performance of infrastructure such as dams, electric, gas, and fuel transmission stations, depends extensively on the data being transmitted by means of these telecommunication towers. Other areas of application for such towers are military and defense industries in addition to television, radio, and telecommunication industries and thus creates the necessity for further research. For that reason, abrupt serviceability or constant function of first-aid-station infrastructure is of crucially main concern in the case of a disaster. Because of their inimitable geometry, telecommunication towers are categorized as slender-tall multi-support structures. The structural engineer faces the tough job of designing and constructing telecommunication towers to bear antenna loads, platform over and above steel ladder loads in open weather with high degree of consistency. The key crisis faced is the complexity in estimating wind loads as they are based on a probabilistic approach. There have been numerous studies in telecommunication towers taking into consideration the wind as well as dynamic effect.

II. MODELING & ANALYSIS

In the modelling of telecommunication tower, the towers are idealised as house frame and modelled mistreatment frame part in Etabs software package. The connections for each towers assumed to be rigid. two towers with heights of 16 m.In low Wind intensity zone have 2 model with X and K bracing.

The behaviour of towered building is studied underneath Wind result, comparative studies of G+30 building with a tower of sixteen-meter height and comparing with X and K bracing in low wind intensity zone. The grade of concrete used is M30 and Fe 500 grades of the HYSD Bars are considered for reinforcing steel also Fe345 grade is used for structural steel such as ISA 200x200x25mm.

A. Modelling Details of Tower

Table I : Details Of Rooftop Tower

Sl. No.	Particulars	Size
1	Height of tower	16m
2	Vertical members	ISA 200x200x25mm
3	Horizontal memers	ISA 200x200x25mm
4	Bracing	ISA 150x150x10mm
5	Section properties	Indian Standard angle section
6	Material property	Fe345

B. Modelling Details of the Building

Table II: Building Description (Preliminary Data)

Sl. No.	Particulars	Size
1	Number of floors	30
2	Floor height	3m
4	Column size	500x650
5	Beam size	300x300
7	Slab thickness	150 mm
8	Wall thickness	External: 230mm Internal: 180mm
9	Live load	3 kN/m2
10	Specific weight of RCC	24 kN/m3
11	Wall load	External: 12.42kn/m3 Internal:9.72KN/m3 Parapet:2.7KN/m3

MODEL IN ETABS

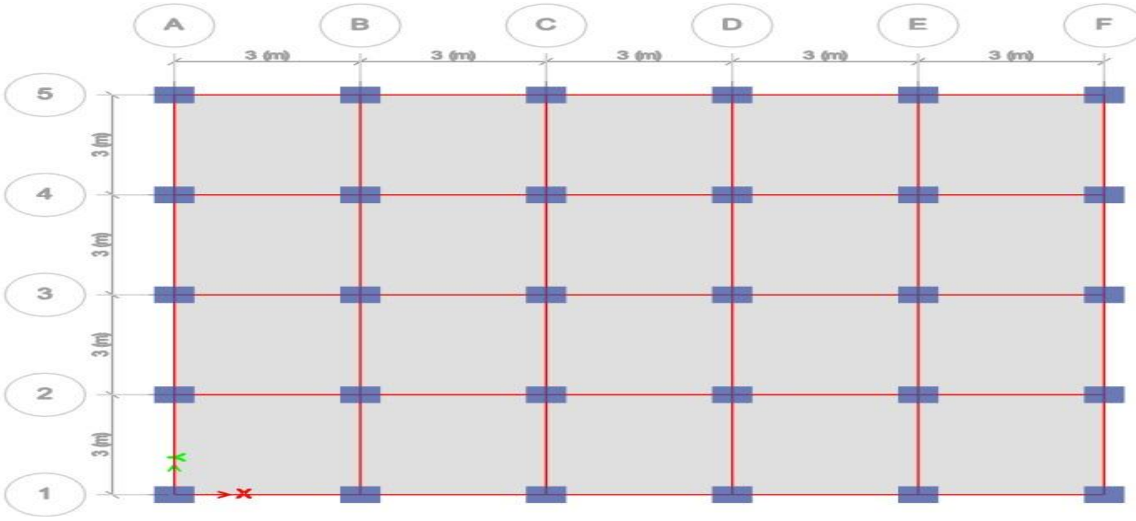

Fig.1 Top view for story 1

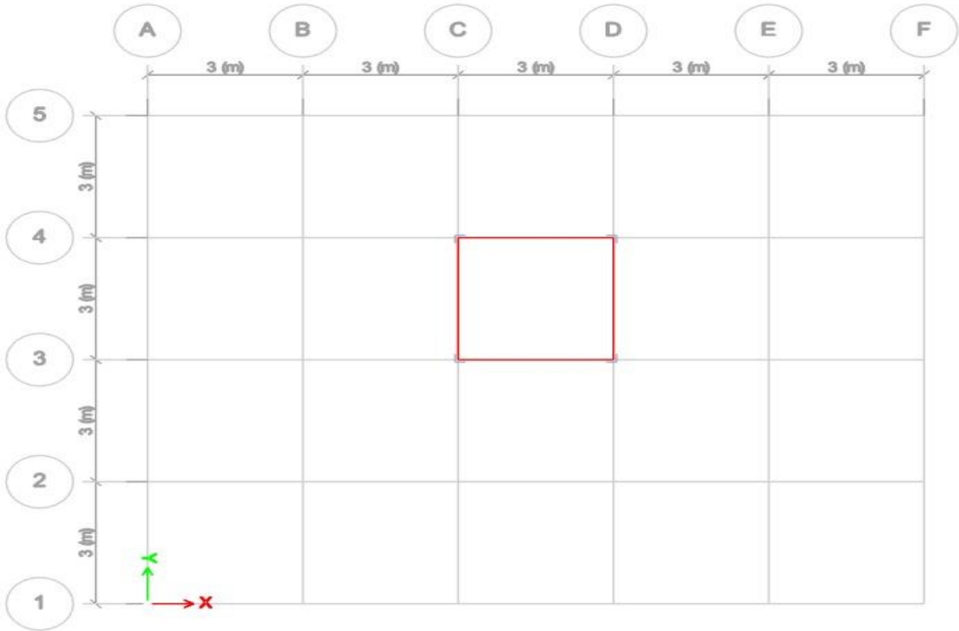

Fig.2 Top view of telecommunication tower

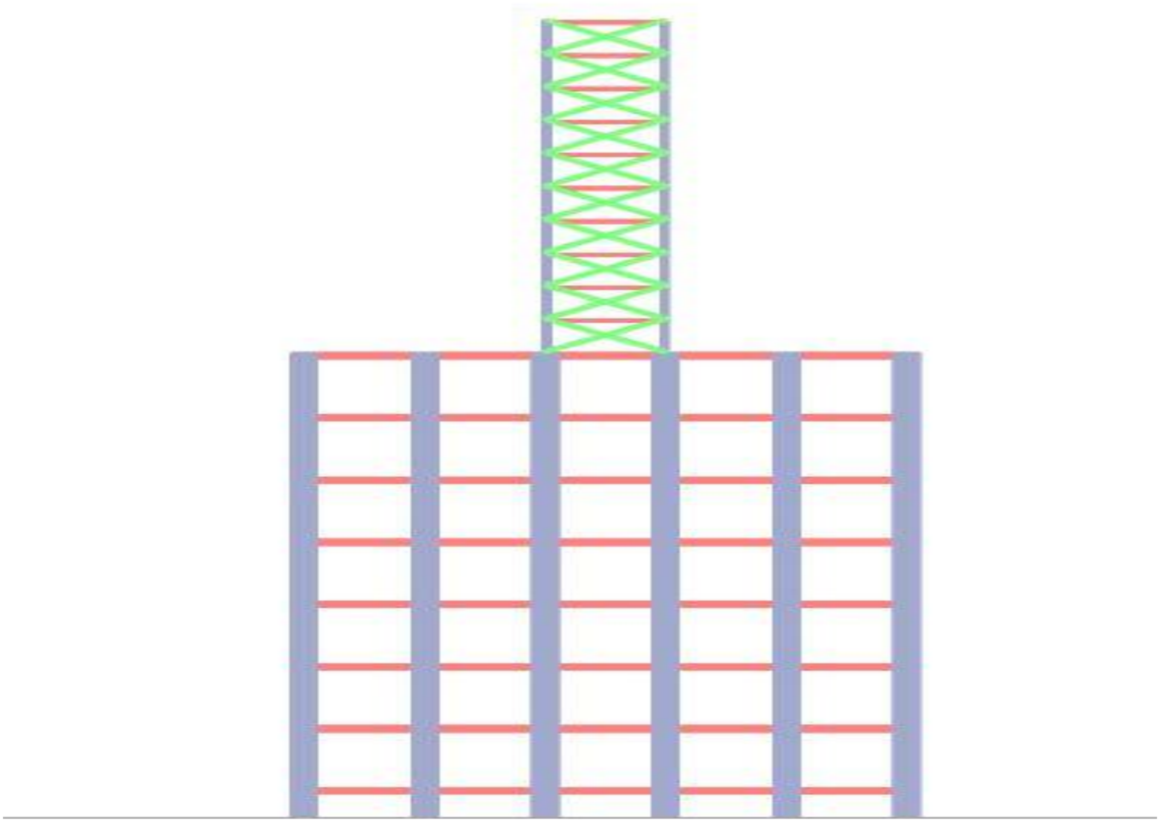

Fig.3 Tower with X bracing

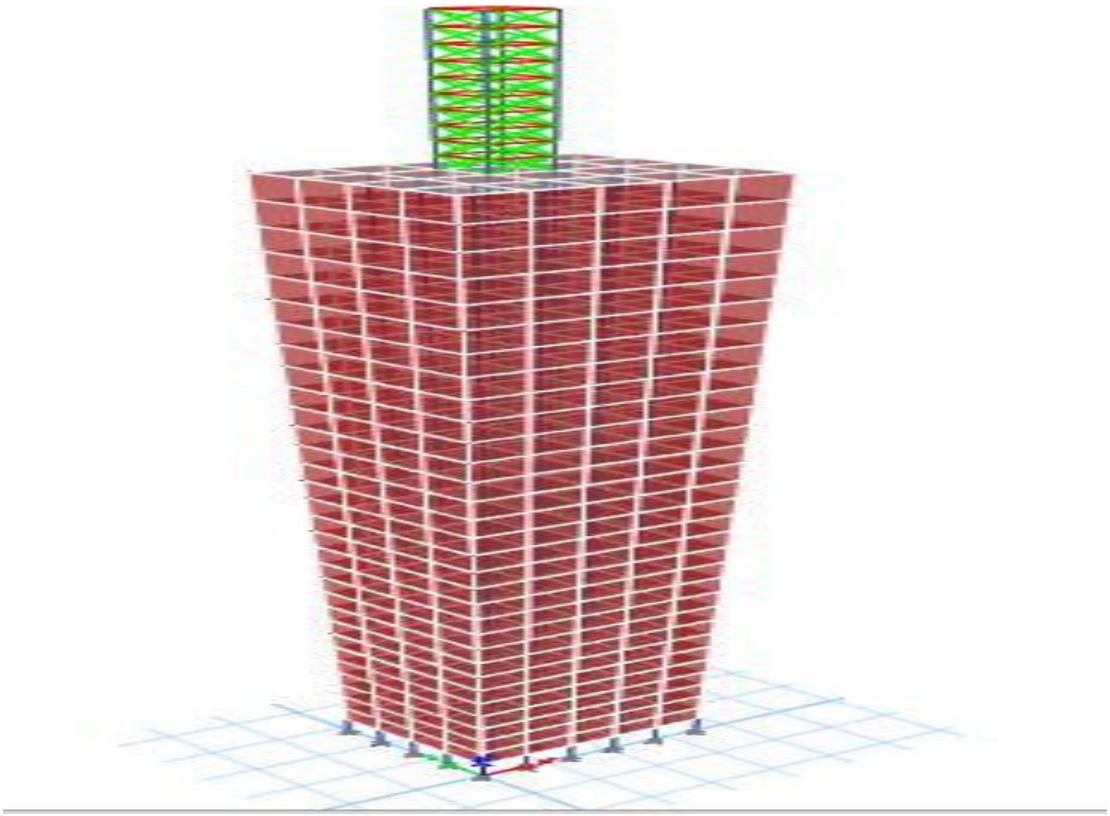

Fig.3D view for G+30 with tower having X bracing

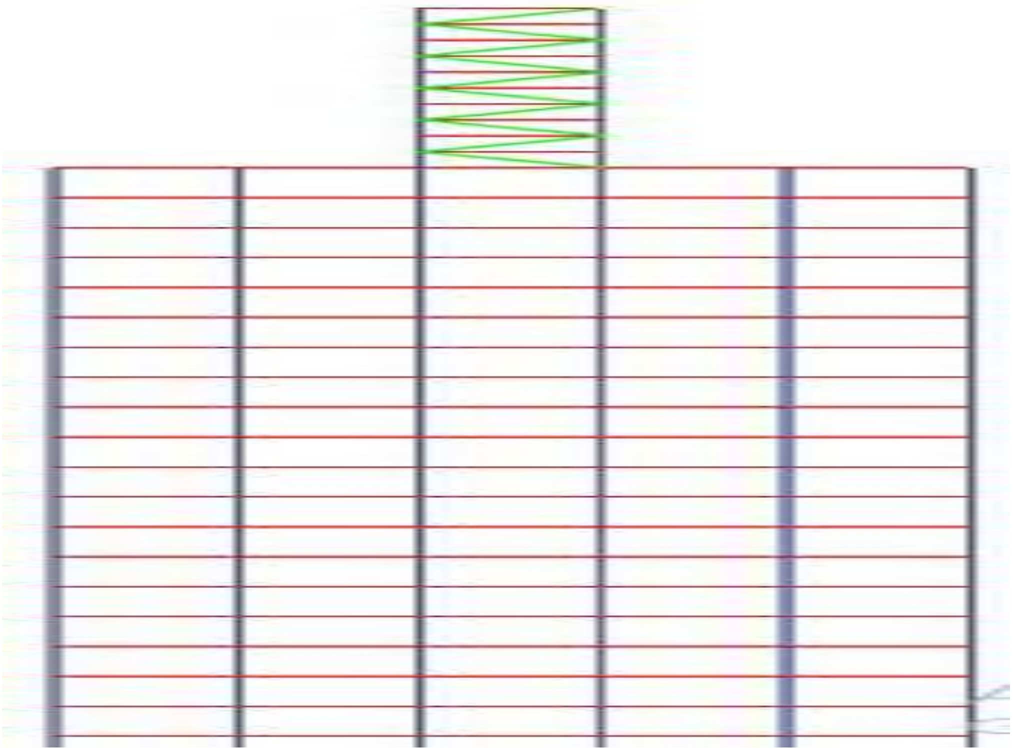

Fig.5 Tower with K bracing

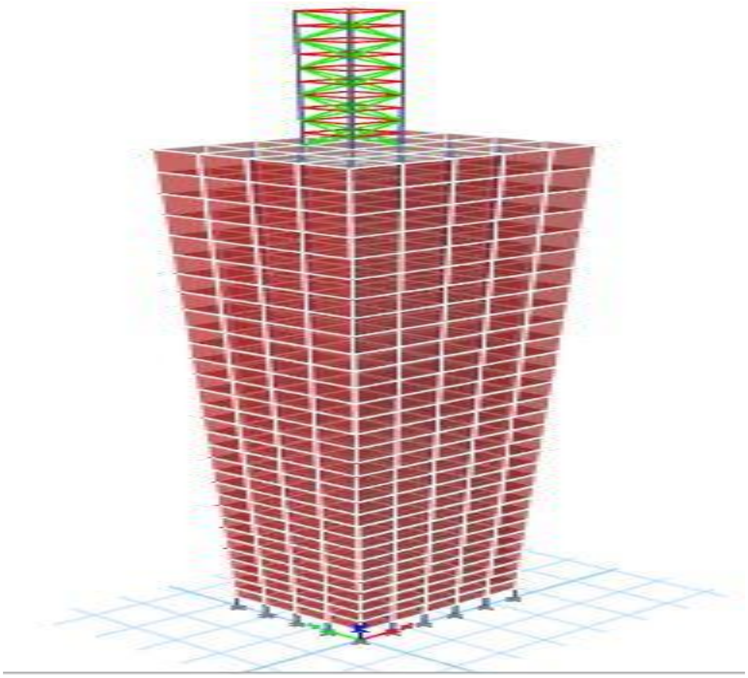

Fig.6 3D view for G+30 with tower having K bracing

C. Wind Loading:

Hourly mean wind speed (Vzh):

- ***a. Vzd = Vzh k1 k3 k4 = 33.585m/sec***
- ***b. Where, Vz = 47m/sec (Design wind speed at height z, in m/s)***
- ***c. k1 = 1 (Terrain, height and structural size factor)***
- ***d.*** k2 = 0.715 (Terrain roughness and height facto)
- ***e.*** k3 = 1 (Topography factor) k4 = 1 (Importance factor for the cyclonic region)

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D. Loads and Load Combination

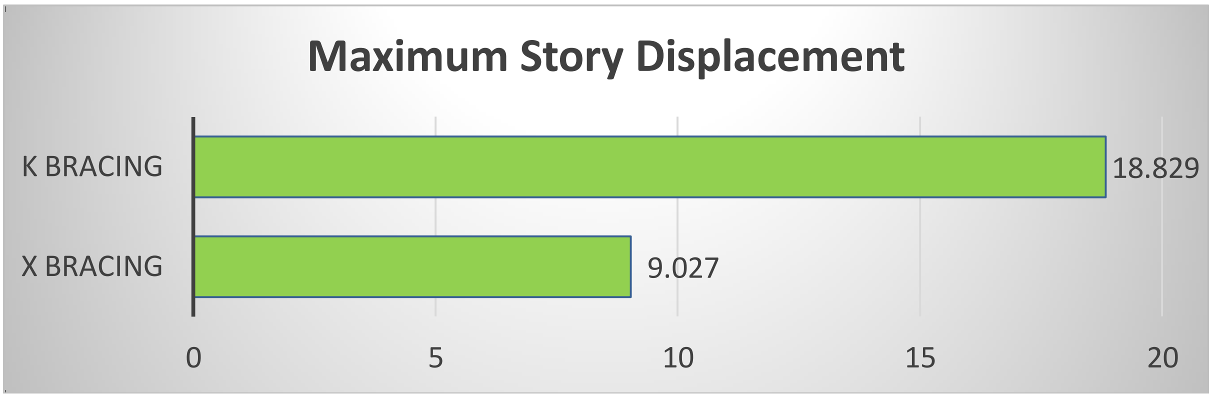
1. DL1.5+WL1.5
2. DL1.5+LL1.5+WL 1.5
3. DL1.2+LL1.2+WL1.2+WIND1.2
4. DL1.2+LL1.2+WL1.2+WIND-1.2
5. DL1.5+WL1.5+WIND1.5
6. DL1.5+WL1.5+WIND-1.5
7. DL0.9+WL0.9+WIND1.5
8. DL0.9+WL0.9+WIND-1.5
9. DL1+WL1
10. DL1+LL1+WL1
11. DL1.5+WL1.5
12. DL1.5+LL1.5+WL1.5
13. DL1.2+LL1.2+WL1.2+WIND0.6
14. DL1.2+LL1.2+WL1.2+WIND-0.6
15. DL1.2+LL1.2+WL1.2+WIND1.2

III. RESULTS AND DISCUSSION

Results analysis is done with low wind intensity zone basic wind speed is 33m/s
The various model is compared here are 16m tower with K and X bracing in low intensity wind zone.

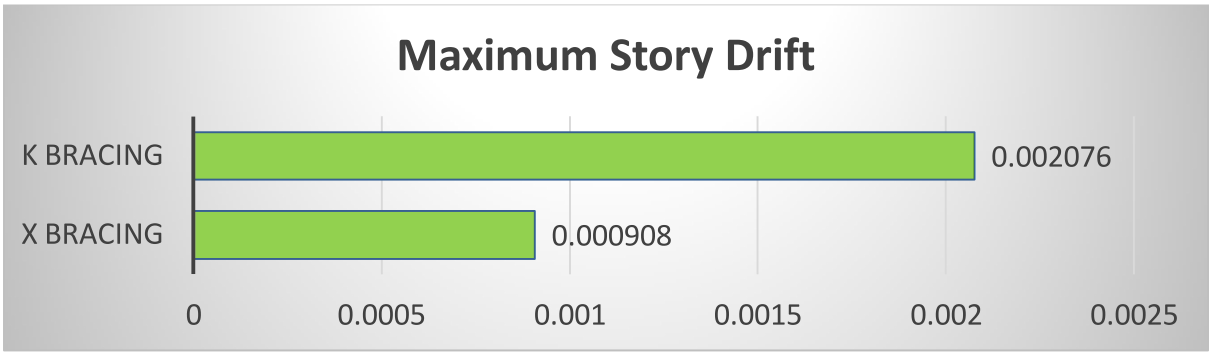
3.1 Maximum Story displacement

Type of Structure	Maximum Story Displacement
Tower with X Bracing Tower with K Bracing	9.027 mm 18.829 mm



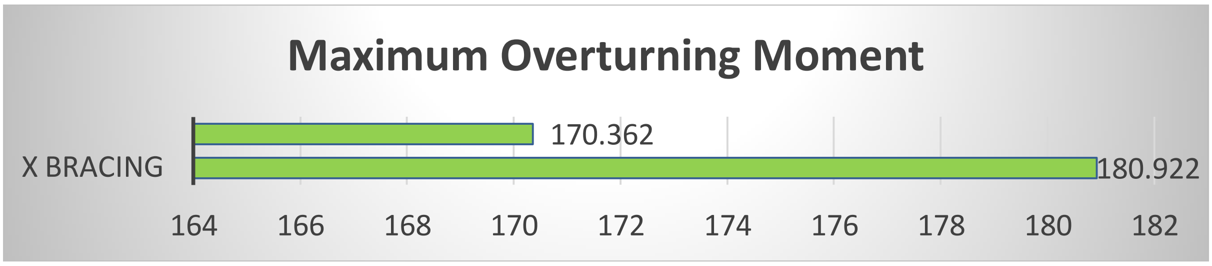
3.2 Maximum Story Drift

Type of Structure	Max Story Drift
Tower with X Bracing	0.000908
Tower with K Bracing	0.002076

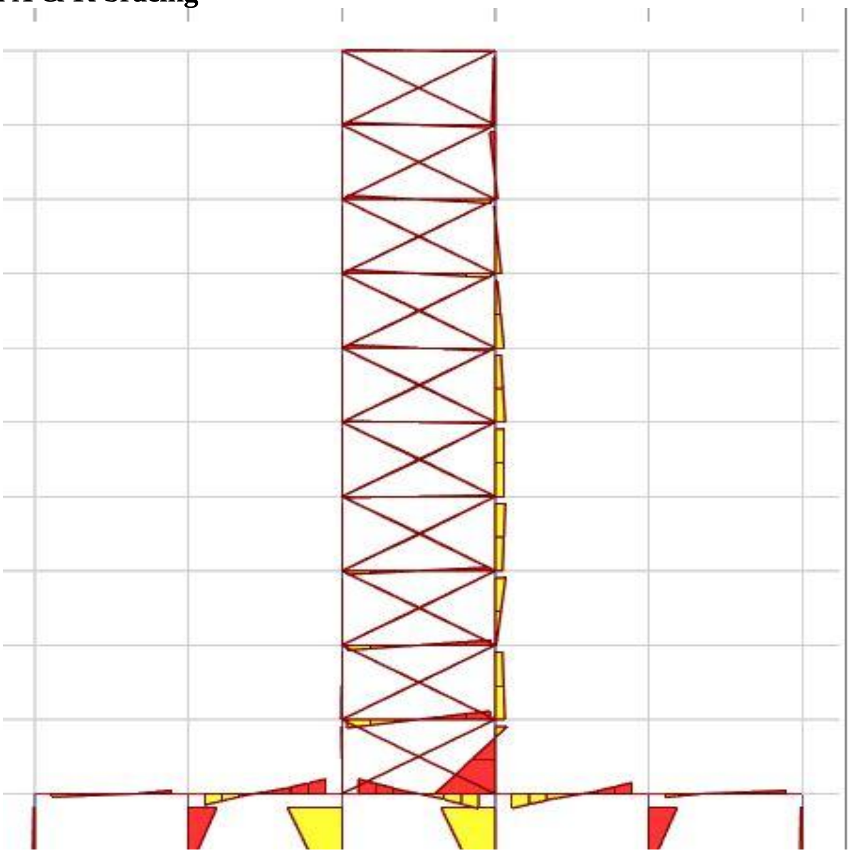


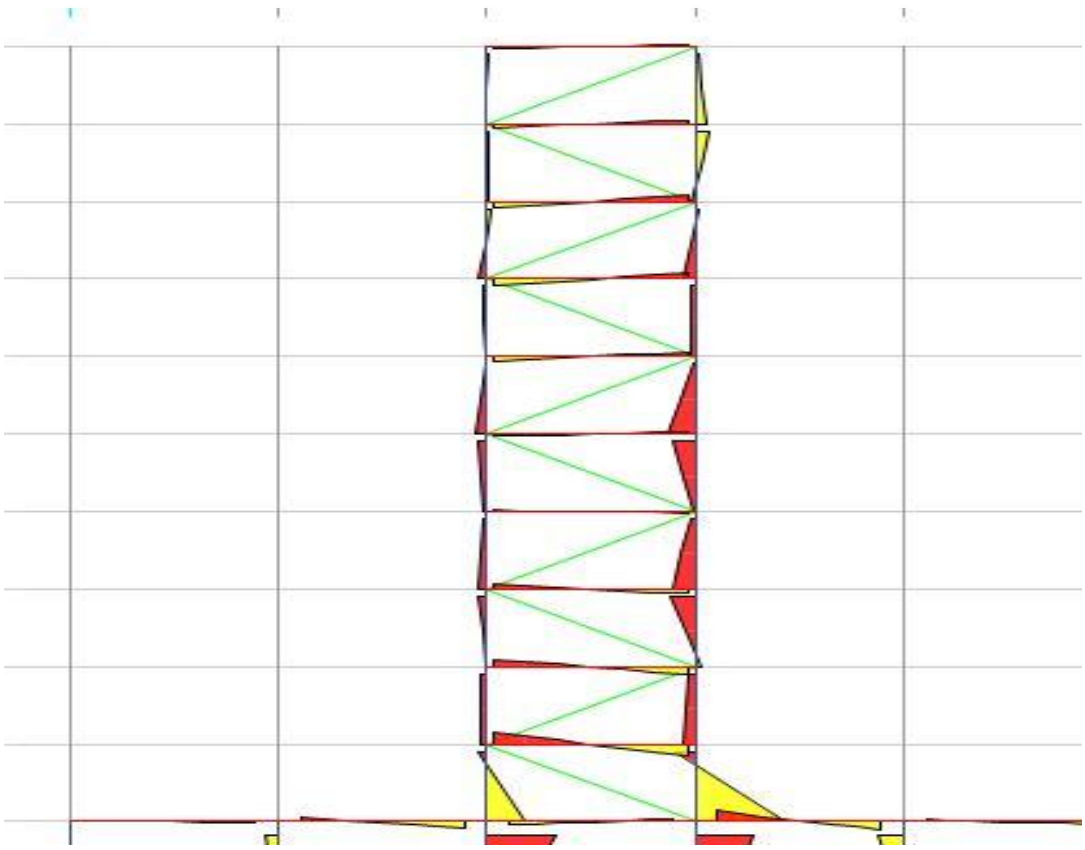
3.3 Maximum overturning moment

Type of Structure	Max overturning Moment (kN.m)
Tower with X Bracing	180.922
Tower with K Bracing	170.362



3.4 Moment in X & K bracing





IV. CONCLUSIONS

- Maximum storey displacement in the telecommunication tower is found 9.027mm and 18.829 mm for X-bracing & K-bracing respectively.
- storey displacement is found 52.05% more in K bracing then X bracing after the application of Low intensity wind force.
- Maximum story drift got lesser in the tower having X- bracing i.e.0.000908 and in K-bracing it is found 0.002076.
- Maximum storey drift in telecommunication tower having K- bracing is near about 52.26% more then that of tower having X-bracing.
- Maximum overturning moment in X-bracing is 180.922 KN.M. and for K-bracing it is 170.362 KN.M .
- Maximum overturning moment in both type of bracing is not having much difference.
- Maximum Overturning moment in tower having X-bracing found more by 5.84% then tower having K-bracing.
- Base reaction in Y-direction for X-bracing is found 4047.37 KN whereas for tower having K-bracing is 4569.44 KN.

REFERENCES

[1]. Keshav Kr. Sharma1, S.K. Duggal2, Deepak Kumar Singh1 and A.K. Sachan2" COMPARATIVE ANALYSIS OF STEEL TELECOMMUNICATION TOWER SUBJECTED TO SEISMIC & WIND LOADING" Civil Engineering and Urban Planning: An International Journal (CiVEJ) Vol.2, No.3, September 2015

[2]. A. Jesumi*, M.G. Rajendran**Optimal Bracing System for Steel TowersA. Jesumi, M.G. Rajendran / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3, Issue 2, March -April 2013, pp.729-732

[3]. A.M.L.N. Gunathilaka, Sri Lanka Telecom PLC,C.S.Lewanagamage,M.T.R. Jayasinghe" ANALYSIS AND DESIGN OF TELECOMMUNICATION TOWERS FOR EARTHQUAKE LOADING IN SRI LANKA FOR SUSTAINABILITY "

[4]. *Alaa C. Galeb 1) and Ahmed Mohammed Khayoon* "Optimum Design of Transmission Towers Subjected to Wind and Earthquake Loading" *Jordan Journal of Civil Engineering,* Volume 7, No. 1, 2013

[5]. Anand Praksh Dwivedi1 Hrishikesh Dubey2" Analysis of Transmission Tower for various Zones of Earthquake Loading at Different Height" *IJSRD - International Journal for Scientific Research & Development| Vol. 4, Issue 07, 2016 | ISSN (online): 2321-0613*

[6]. C Preeti1, Sankara Ganesh Dhoopam2" COMPARATIVE STUDY OF FOUR-LEGGED SELF-SUPPORTED ANGULAR TELECOMMUNICATION TOWER ON GROUND AND MOUNTED ON ROOF TOP" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308

[7]. Hemal J shah, Dr. Atul K Desai" Non-Linear Time History Analysis of Tall Steel Tower Considering Soil Structure Interaction" International Journal of Engineering Research & Technology (IJERT)http://www.ijert.org ISSN: 2278-0181 IJERTV6IS030284 (This work is licensed under a Creative Commons Attribution 4.0 International License.) Vol. 6 Issue 03, March-2017

[8]. Sachin Paul1, Eldhose M Manjummekudiyil 2Seismic Study of Building with Roof Top Telecommunication Towers" International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 3, March 2013)

[9]. M.Selvaraj1, S.M. Kulkarni2, R.Ramesh Babu3" Behavioral Analysis of built up transmission line tower from FRP pultruded sections" International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 9, september 2012)

[10]. Siddesha.H," Wind Analysis of Microwave Antenna Towers" INTERNATIONAL JOURNAL OF APPLIED ENGINEERING RESEARCH, DINDIGUL Volume 1, No 3, 2010

[11]. Harsha Jatwa, Vivek Tiwari, Sumit Pahwa," Comparative Study of Indian and ASCE Codes Provision for Design of Transmission Tower" International Journal of Innovations in Engineering and Technology (IJIET)

[12]. V. LAKSHMI, M.V.R. SATYANARAYANA, V. RAVINDRA'STUDY ON PERFORMANCE OF 220 kV M/C MA TOWER DUE TO WIND" V. Lakshmi et al. / International Journal of Engineering Science and Technology (IJEST)

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